Basophilic Aggregation Test in the Lead Poisoning Epidemic of 1934-1935*

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THE automobile production year 1934–1935 marks the outstanding epidemic of lead poisoning in this country for at least the past decade. This epidemic appeared in the automobile industry, which industry has been substantially free from lead poisoning since the abandonment of the dry-sanding of wooden bodies painted with lead-containing paints. This preceding epidemic was described by Dean in 1924.[1] The present epidemic has prevailed among the several thousand workers engaged in automobile body manufacture.

Recent trends in body design have led to one-piece, all-metal bodies with non-air-resisting contours. The manufacturing processes entailed call for the filling in of all welding depressions and other indentations with a lead-tin alloy. This leads to the use of molten lead pots and torch work, which in turn are followed by various processes for the smoothing down of the leaded surfaces, including power grinding, hand filing, sanding, etc. As a result the atmosphere of these workrooms is polluted by harmful quantities of lead dust and lead fume. Occasionally as much as 1,100 mg. of lead have been encountered in 10 cu. m. of air, which amount of air approximates the quantity of air breathed by the average workman during the usual work day. However, the usual amount of lead in this quantity of air has ranged from 10 to 40 mg.

This type of lead exposure has brought about a high incidence of lead poisoning, together with the much larger groups of workers in whom proof of lead absorption has been established but who have not suffered subjective injury and have not lost time from employment. It is not possible to state the extent of lead poisoning during the past 12 months in the entire automobile industry. If the figures obtained from studies in a limited number of plants may be extended to the industry as a whole, it is possible that as many as 4,000 workmen have been injured to some extent during the 1934–1935 automobile production season. At best this figure is an approximation, and further it is emphasized that by no means does this number represent only actual clinical cases of lead poisoning.

During the past 10 years there have been many affirmations that industrial lead poisoning is a waning disease. While in some measure this has been true up until 1934, the outstanding fact is that it is the severity of the affection that is waning, rather than the frequency. Very strikingly this has been borne out by the present epidemic.

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As far as is known among the large number of cases, there have been no proved deaths, little profound encephalitis, very few instances of wrist drop or foot drop, etc. With certainty it may be believed that there have been milder degrees of neuromuscular injuries, encephalitis, etc. The outstanding and almost uniform manifestations have centered about involvement of the gastrointestinal tract, accompanied by excessive fatigability and blood changes.

Already the work conditions that produced this recent epidemic of lead poisoning have been modified in many plants to the extent that large numbers of additional cases of lead poisoning are unlikely. In some plants elaborate protective devices and procedures have been introduced. As yet no practical substitute has been found for the lead-tin alloy, inasmuch as certain other alloys that otherwise might be used may not be used due to prohibitive costs, undue shrinkage, etc. All in all, it may be stated that at least in some automobile plants the lead hazards have been brought under control.

This recent epidemic has provided us a long sought opportunity for the extended investigation of a diagnostic procedure first utilized by us in 1924.[2] Already a publication [3] has been made on this recent experience up to the time that 1,600 tests had been carried out. At this time the results of nearly 8,000 tests are available for the appraisal of the method. This test is based upon the enumeration of the total number of basophilic containing cells in the blood, in distinction to the widely used procedure of enumerating preformed stipple cells, the value of which method is now somewhat questioned. The method as carried out is similar to that lately used by Jones and his associates.[4] Since the basophilic formations as seen in the microscope do not exist as such in the blood stream and are artifactually produced in the process of preparation and staining, we prefer to use the term "Basophilic Aggregations," which term uniformly appears in the subsequent discussion of this test and our experience with it, which now follow.

BASIC PRINCIPLES

In normal adult human life, the content of erythrocytes in the blood stream is maintained on a fairly uniform level by the orderly entry of new cells from the bone marrow replacing those that have been destroyed.

These new cells are essentially mature, only about 1 per cent exhibiting any of the several known characteristics of immaturity. In bone marrow, during the formative period of erythrocytes, an entirely different cytology takes place varying with the stage of development of the red cells. Readily there may be demonstrated nuclei, protoplasm, and basophilic substance. In due time a change not known for any other cells of the body occurs; a chemical (hemoglobin) replaces the protoplasm and the nucleus is extruded. The erythrocyte is then ready for its chief function in the circulatory blood. These phenomena are set forth admirably in Key's [5] fundamental paper on erythrocytic cytology. The mechanism which liberates cells when mature and conversely retains undeveloped cells is not known. However, the functioning of such a mechanism is well established.

Under conditions in which toxic agents exert an action on bone marrow, and under other conditions in which physiologic demands are made, increased numbers of erythrocytes enter the blood stream. As examples of the former may be cited lead, benzol, toluol, xylol, possibly arsenic and chlorinated hydrocarbons, such as carbon tetrachloride; of the latter the effects of high altitudes constitute an obvious instance. The chief charac-

teristic of these liberated immature cells is the presence of basophilic substance.

Polychromasia (polychromatophilia), punctate stippling, and reticulation are but different manifestations of one phenomenon—the presence of basophilic substance. The exact form of this basophilic substance existing in the unaltered blood is little known. Probably the picture observed as polychromasia after staining is nearest to the natural state of this material. The impression furnished by all available evidence is that of thousands of ultramicroscopic particles in acid suspension, or possibly in their innate form in acid solution. Reticulated cells probably are produced only as a result of laboratory manipulation and thus while not being true artifacts are laboratory creations. With suitable laboratory facilities one is able to observe through the microscope the actual formation of reticular processes in cells not previously exhibiting such reticulation. Through variations in laboratory technic, the experimenter may produce at will in a single blood smear all the well known varieties of reticulation, as fragmented, anastomosing, wreaths, mossy forms, etc. If the artificiality of reticulation be accepted as fact, then such terms as "reticulocytosis" conceivably may be regarded as anomalous, in so far as these terms betoken the existence of reticular forms in the circulating blood. However, stippled cells are believed to exist as such in the unaltered blood. Through unknown processes, the ultramicroscopic particles observed as polychromasia or the basophilic materials in acid solutions, are caused to arrange themselves into masses characteristic of stippling. From the literature these concepts are well borne out in substantial publications, brief excerpts from which are now recorded.

Key [5] notes:

> If an individual reticulated cell be watched carefully during the process of staining, the net can be seen to grow under the eye of the observer as though it were being formed by precipitation of the substance from the surrounding medium.
>
> It is difficult to conceive that fixatives cause a definite network to break up into ultramicroscopic particles and become uniformly distributed through the cell (*i.e.*, polychromatophilia). Fixatives tend to fix intracellular products *in situ*. It is consequently felt that the conclusion is warranted that the reticular network as seen in supravitally stained erythrocytes is formed only during the process of staining and that no such structure exists in the unaltered erythrocyte.
>
> My observations lead to the belief that the granules of punctate basophilia are formed of the same basophilic substance which in simple anemias gives pictures of polychromatophilia and that because of the pathologic process the substance is aggregated into small granules in the cell [punctate stippling].
>
> With Wright's stain allowed to dry on a slide to which salt solution and blood is added, no polychromatophilia is seen but a definite basophilic reticulation slowly appears in the basophilic erythrocytes.
>
> Basophilic substance (*i.e.*, as a term) is preferable to "reticular substance" since reticulations are artifacts due to the action of a stain on a substance distributed uniformly through the cell.

In Hawes's [6] work no distinction was made between polychromatophilia and stippling, but when total percentages of the two were added the results corresponded with fair constancy with the total percentage of reticulated cells enumerated by other means on the same blood. Such differences as were encountered were attributed to differences in the delicacy of the methods used and not to any true excess of reticulated cells.

Jones [4] observes: "This (basophilic) substance is demonstrated either in the form of polychromatophilia, punctate basophilia, or reticular designs, depending upon the staining method used."

Basophilic substance long has been regarded as the foremost blood finding in lead poisoning, but to an overwhelming extent reliance has been

placed upon the determination of stippled cells. Recognition that polychromatophilia, punctate stippling and reticulation are but different aspects of the same material, should prompt the placement of greater diagnostic dependence upon examinations for the totality of erythrocytes containing basophilic material. Of the three forms of basophilic substance, stippled cells are the least common. The positive diagnostic significance widely attached to the qualitative finding of stippled cells in suspected lead poisoning is becoming more and more questionable; conversely less uncertainty is believed to attend the quantitative determination of all basophilic erythrocytes.

TECHNICAL PROCEDURE

The blood of normal human adults rarely contains more than 1 per cent of basophilic erythrocytes. The average in our experience lies between 0.4 and 0.8 per cent. With workers absorbing lead without clinical manifestations and in early lead poisoning, the percentage commonly ranges from 1.5 to 4.0 per cent, with occasional findings up to 20.0 per cent. The zone between 1.0 and 1.5 per cent represents the threshold, findings within which being open to doubt. In the absence of other pathology, any finding in lead exposed workers of, or in excess of, 1.5 per cent at once suggests the probability of lead absorption. Findings in excess of 2.0 or 3.0 per cent are to be associated with an increased imminence of clinical lead poisoning.

Search for these basophilic forms is best made in laked cells. When laking takes place some of the basophilic substance probably leaves the cell with the hemoglobin. The remainder, being insoluble in water, salines, and some stains, collects in masses, strands, and reticula, as laboratory artifacts. Such forms are far more visible than polychromatophilic cells and are more numerous than stippled cells.

In our first work [2] a thick, even blood smear was entirely laked. The number of basophilic aggregations in an average of many uniform microscopic fields was interpreted in relation to our clinical observations of the persons examined either as controls or as leaded patients. This procedure justly has been criticized as not readily transferable to others for quantitative work, since the making of uniformly thick smears by divers persons is most unlikely. Under rigid research conditions this earlier method will yield quantitative results but now is not the preferred procedure. The technic now employed is here presented:

The Sussmann-Weindel stain advocated by Jones is quite satisfactory when its several ingredients are pure. The formula is as follows:

Toluidine blue	0.5 gm.
Borax	0.05 gm.
Methylene blue solution (Loeffler's)	5 c.c.
Distilled water	100 c.c.

Our experience with this stain has been that it is not uniform from one batch to the next. Most of the trouble may be traced to the toluidine blue. Of six samples of this dye recently purchased by us from various supply houses, only one was found to be satisfactory.

A modified Manson's methylene blue yields more consistent results. The formula is as follows:

Borax	1.0 gm.
Methylene blue	2.0 gm.
Distilled water (boiling)	100 c.c.

The borax is dissolved in the boiling distilled water and to this is added the methylene blue. After filtering, this stain is ready for use and provides a stable, satisfactory, and uniform stain for at least 2 weeks. If used for long periods, a progressive formation of

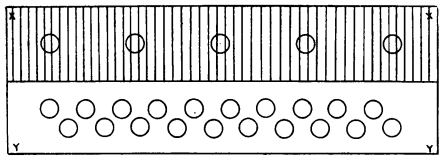

FIGURE I. Schematic arrangement indicating fixed (x, x) and unfixed (y, y) portions of slide, together with counting procedure on uniform slide.

precipitate may appear. However, due to the low cost and ease with which this stain is prepared, we consider this a small handicap. This stain is less stable than the Sussmann-Weindel, but in our experience gives more trustworthy results.

Thin, even blood smears are made on slides and allowed to dry. The proper drying of these smears becomes important. If permitted to become excessively dry, that is, longer than 12 hours, some of the basophilic containing cells will not lend themselves to aggregation of their basophilic material. On the other hand, insufficient drying facilitates removal of cells during the staining period. Ordinarily the optimum time lies between 1 and 3 hours. Under peculiar industrial conditions, involving high temperatures and low humidity, or conversely high humidity, special consideration for the drying period may be required.

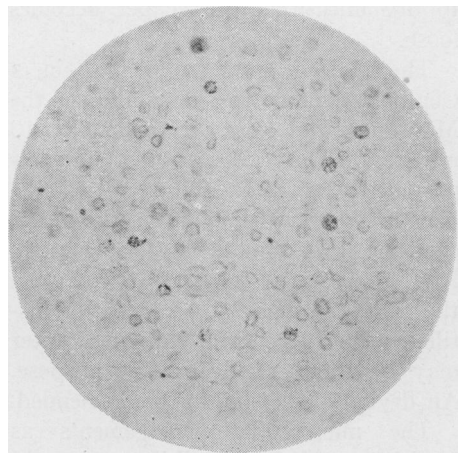

FIGURE III. Typical microscopic field from fixed portion of same slide as in Figure II, presenting unlaked, stained red blood cells. Lines of Whipple grid used as guide in counting may be seen.

After drying, one-half of the slide is overlaid by a strip of filter paper, as set forth by Jones, and cautiously there is applied with a pipette or dropper the minimum amount of methyl alcohol C. P. (methanol, wood alcohol) required to moisten the filter paper until it clings to the slide. This is allowed

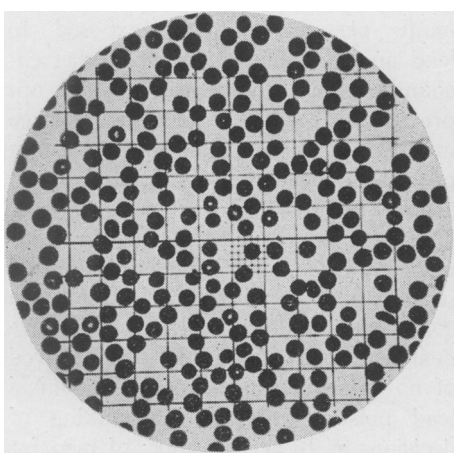

FIGURE II. Typical microscopic field from unfixed laked portion of slide presenting numerous basophilic aggregations.

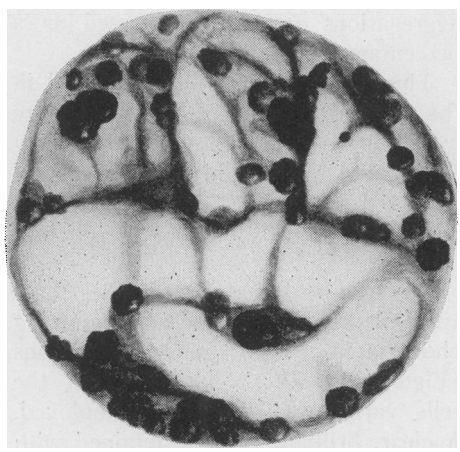

FIGURE IV. Semi-schematic drawing of a basophilic aggregation in laked red blood cell. Manson stain. Magnification in original drawing: 17,000.

to dry until the filter paper becomes loose.

The slide is now submersed in a Coplin staining jar, containing the Manson stain, for approximately 10 minutes. The time is of minor importance since a readable stain may be had in 2 minutes, and on the other extreme it is impossible to overstain. After staining, it is necessary to wash the slides through 3 or 4 rinses of distilled water. In some cities tap water may be safely used for this purpose. Air drying of the slides is recommended.

The microscopic arrangements as used by us provide an oil immersion objective and a 10X ocular, which is fitted with a Whipple grid. The outer lines of this grid determine our microscopic field (Figure III). The average field in a good preparation contains approximately 150 red blood cells. Before counting, the slide should be examined for an area showing suitable distribution of the red cells. In the unfixed portion of the slide, customarily 10 consecutive fields in two parallel rows are counted, making a total of 20 fields, but in the more evenly distributed slide 20 consecutive fields. Then moving to the fixed portion of the slide, 5 appropriately corresponding fields are counted (Figure I). The basophilic aggregations are then expressed as a percentage of the latter.

Thus, if in the 20 fields counted in the unfixed portion of the slide there were found 76 B.A.s (Basophilic Aggregations), and if in the 5 fields of the fixed portion 1,000 red blood cells (or 4,000 in 20 fields), the obvious percentage is 1.9.

The physical features of the B.A.s are best presented in the accompanying photographs and photomicrographs (Figures II, IV). The color of the cells varies with the stain employed. A clear, brilliant blue is obtained with the Manson stain. A hand tally is used in the enumeration of the cells.

RECENT RESULTS

During 1934 and the first two-thirds of 1935, approximately 8,000 examinations were made, using the technic just described. The examinees represent employees in 16 plants and 6 different industries. Included in the 8,000 tests made are several hundred controls usually obtained from office groups. The lead exposed workers were distributed over the following industries: lead pigment manufacture, paint and other coatings manufacture, soldering, lead casting, lead oxide manufacture and application, and lead smelting. In some plants, but not all, concurrent determinations were made as to the amount of lead in the atmosphere expressed in terms of mgs. of lead per 10 cu. m. of air. In the aggregate, 416 quantitative lead determinations were made. The results from the basophilic aggregation tests have been correlated with the findings of the quantity of lead in the atmosphere breathed by exposed workers.

During 1934, basophilic aggregation tests were carried out simultaneously with stipple cell determinations, and in some instances with hemoglobin measurements and total red cell counts. Very early it was established that no consistent correlation was present. In many persons wholly unexposed to lead an occasional stipple cell was encountered and among lead workers approximately 90 per cent presented large numbers of stipple cells in the absence of clinical lead poisoning, and often after 3 months of no exposure to lead. The number of stipple cells in lead-using workers without clinical lead poisoning ordinarily was lower than 3,000 per million. The qualitative demonstration of stipple cells proved of no value in the diagnosis of clinical lead poisoning or in the making of decisions as to acceptability of men for continued work. Many workers regularly exhibiting stipple cells in

their blood smears passed through the entire automobile production season without illness and without any lost time. In similar fashion it was found that no significant diagnostic values resided in the routine determination of hemoglobin percentages or in total red cell counts. Over and over high percentages of basophilic aggregations were detected with no significant changes either in the hemoglobin or in the erythrocyte counts. For this reason all blood work other than the basophilic aggregation tests was abandoned as routine procedure in plant surveys, although complete blood work was carried out in the management of clinical cases of lead poisoning.

The trend of findings from 8,000 basophilic aggregation tests are now shown in three specimen tables.

Table I comprises the results from 25 representative controls. In establishing normal ranges of basophilic cells only such persons were utilized as were known to be essentially unexposed to lead and definitely unexposed in industrial pursuits. Almost without exception control examinees present less than 1 per cent of basophilic containing cells.

TABLE I

Initials	*Per Cent Basophilic Cells*
R. T.	0.4
E. T.	0.7
J. J.	0.4
L. H.	0.9
G. O.	0.5
S. M.	0.3
K. F.	0.6
R. H.	0.3
H. D.	0.9
M. G.	0.4
G. C.	0.5
O. L.	0.4
W. F.	0.2
J. B.	0.7
F. W.	0.4
H. K.	0.6
W. B.	0.2
J. R.	0.3
H. F.	0.7
W. K.	0.5
E. S.	0.3
C. W.	0.6
R. B.	0.3
L. K.	0.6
C. V.	0.4

TABLE II

Initials	*Age*	*Per Cent Basophilic Cells*	*Length of Time on Present Job*
C. S.	41	2.1	14 years
V. D.	37	1.2	8 years
J. M.	48	1.4	6 years
T. K.	34	3.5	9 years
J. K.	46	1.1	7 years
G. F.	41	3.2	1 year
A. S.	47	3.1	4 months
D. T.	55	2.3	6 years
G. B.	37	0.4	2 years
G. K.	30	1.5	10 months
T. M.	35	5.5	2 months
K. W.	29	1.6	5 years
E. C.	53	0.7	3 years
S. P.	30	2.0	5 years
V. T.	38	1.6	4 months
A. C.	36	3.3	1 month
F. N.	45	1.7	8 years
S. H.	28	1.4	3 years
J. G.	33	2.5	6 years
J. C.	32	0.5	2 years
C. C.	27	1.4	3 years
F. L.	40	2.4	4 years
J. S.	33	2.5	6 years
L. K.	47	1.9	4 years
C. R.	50	1.3	21 years

In Table II may be found the results of 25 workers in an atmosphere containing lead to the extent of 14 mgs. per 10 cu. m. of air. In contrast to the control table just preceding, a fair number of these examinees present findings above 1.5 per cent. It is among workers having such findings as these that clinical cases of lead poisoning may be expected to arise. Almost uniformly it has been noted that the higher the lead content of the atmosphere the higher the percentage of exposed workers showing positive basophilic aggregation findings. On the other hand it has not been found that the percentage of basophilic cells increases with any uniformity in keeping with increases in the lead content of the atmosphere. An occasional worker may yield as high a figure as 10 or 15 per cent of B.A.s but this is not the rule and the majority of affected

workers regardless of the amount of the exposure will present positive findings in the range of from 2 to 6 per cent.

With the procurement of better work conditions, as reflected by lowered quantities of lead in the atmosphere, there occurs a corresponding diminution in the number of persons showing positive tests, although there is a lag of from 1 to 2 weeks before this drop may be demonstrated. This correlation between lead in the atmosphere and positive blood smears is reflected in Table III.

TABLE III

BASOPHILIC AGGREGATION TEST RESULTS ON WORKMEN BEFORE AND AFTER THE LEAD CONCENTRATION WAS REDUCED FROM 75 MG. PER 10 CU. M. OF AIR TO 4 MG. PER 10 CU. M. OF AIR. ELAPSED TIME: 35 DAYS.

Initials	*Per Cent B. A. Cells When 10 cu. m. of Air Contained 75 mg. of Lead*	*Per Cent B. A. Cells When 10 cu. m. of Air Contained 4 mg. of Lead*
M. V.	2.0	0.8
T. S.	2.1	0.7
A. L.	2.0	1.0
J. B.	3.2	4.6
W. H.	2.0	0.9
C. H.	3.4	1.4
J. T.	2.1	0.6
K. S.	2.7	2.0
C. S.	4.3	3.4
C. M.	2.6	1.6
V. K.	2.4	0.5
M. S.	3.0	0.9
C. G.	2.0	0.8
C. B.	2.0	1.0
J. E.	2.0	1.7
D. D.	2.5	2.2
D. T.	2.2	3.2
W. W.	1.1	4.0
J. K.	3.2	1.3
G. R.	3.0	0.8
G. C.	2.0	0.5
J. P.	2.1	1.6
A. R.	2.0	0.8
I. L.	3.1	2.4
P. P.	8.5	5.3

This specimen material is characteristic of the entire investigation, with one exception. In one plant, manufacturing a great variety of pigment materials, lead poisoning was known to be present but the basophilic aggregation tests were not found to be in keeping with our general experience. The assumption is that because of the multiplicity of chemicals manipulated some biological antagonistic factor interfered with the usual reaction of the embryonic red cell to lead.

The chief application of this test has been in the routine examination of large groups of lead exposed workers. The results of such tests have been utilized as a guide for the transfer of workers to less hazardous departments, in the appraisal of the degree of exposure in different departments, in determining the effect of preventive measures, and in the differential diagnosis between lead poisoning and conditions simulating this disease, but in routine work its greatest single value has been associated with the detection of malingerers. During this epidemic in some plants, as high as 90 per cent of all exposed workers have simulated lead poisoning presumably in order to be eligible for insurance and sick benefits during the nonproductive season in the automobile industry. In some instances this basophilic aggregation test has been accepted as a sufficient criterion for the weeding out of these malingerers.

GENERAL COMMENT

In persons exposed to lead, otherwise free from disease, the detection of basophilic containing red cells in percentages in excess of 1.5, and particularly in excess of 2 per cent, suggests lead absorption and the possibility of approaching clinical lead poisoning.

Inconclusive proof is available that this test may be positive after exposure to other substances such as benzol, toluol, xylol, arsenic, etc. Occasionally in infectious diseases numbers of basophilic aggregations above the usual may be found. Manifestly in anemias and other types of diseases involving the red blood cells, normal ranges may be exceeded.

The length of exposure to lead ap-

pears to have no significant bearing upon the basophilic aggregation findings. Two weeks' exposure is ample to bring about increased numbers of basophilic containing red cells. New workers employed alongside of workers employed for a longer period are prone to show a greater frequency of response than the older workers.

In prolonged chronic lead poisoning the test described appears to be of limited value. The recession in the number of basophilic aggregations may be definite in long existing lead poisoning even in the presence of frank manifestations. Under such conditions punctate stippling may persist.

In many publications the minimum amount of lead that may lead to lead poisoning is specified as from 1 to 2 mg. as a daily intake. While this figure may represent a primary threshold at which an occasional case of lead poisoning may arise, it is our experience that many hundreds of workers continue at employment in concentrations much higher without demonstrable impairment. Without denying the possibility that a daily intake of 1.5 mg. of lead may produce lead poisoning, the belief is expressed that the practical threshold may be considerably higher and in the general range of from 4 to 8 mg. At least, years of exposure to such concentrations have not led to a single recognized case of plumbism in several plants included in this investigation.

One of the practical advantages served by this test as described lies in the fact that large numbers of persons may be examined daily. In our experience, a single worker has been able to collect as many as 300 specimens per day. Laking, staining, and cell counting, subsequently carried out, necessarily must be at a slower rate, but on a single day, as many as 70 counts have been made by one experienced technician. This rate of work stands in contrast to stipple cell enumeration, which if properly carried out ordinarily yields not more than 20 determinations daily.

SUMMARY

In the 1934–1935 epidemic of lead poisoning in the automobile industry, 6,900 basophilic aggregation examinations of the blood were made. In addition during this period 1,100 tests were made in other industries, thereby totalling 8,000 tests during the investigation. This number includes approximately 500 control examinations made upon workers unexposed to lead.

Positive basophilic aggregation tests, the method for which is described in detail, have served as an index for lead absorption prior to the appearance of clinical manifestations of lead poisoning. This test has proved to be of value in the diagnosis of early cases of lead poisoning. An approach to this test was described by us in 1924. Through technical improvements, made by others and by us, this procedure is now suited to application by any physician or laboratory carrying out any blood examinations.

The basic principle in the basophilic aggregation test is the enumeration of red blood cells containing basophilic substance, in contrast to the customary procedure of qualitative or quantitative examination for stipple or polychromatophilic cells.

The native state of basophilic material in unaltered red blood cells is not known, but in the process of laking and staining red cells this substance may be artificially aggregated into readily visible masses. In normal human adults, these aggregates rarely exceed 1 per cent of the total number of erythrocytes, but in lead exposed individuals the percentages ordinarily lie above this normal maximum, when considerable lead is being absorbed or when clinical lead poisoning is im-

minent. Findings of percentages above 1 to 1.5 per cent and especially above 2 per cent in persons exposed to lead at once suggest lead absorption and the possibility of approaching lead poisoning, or the actuality of early lead poisoning.

In chronic lead poisoning this test usually is not, but may be, positive. As lead poisoning progresses to extended chronicity, the reliability of the procedure diminishes. This test has been utilized in lead-using industries to determine the number of exposed workers absorbing lead, as some proof of existing lead hazards, as a guide for the transfer of lead absorbing workers to lead-free departments, as a measure of the efficacy of preventive devices and practices, and as a means for the detection of malingerers.

There are varied types of diseases leading to positive basophilic aggregation tests, but in groups of workers in lead industries, presumably normal except for the possible effects of lead exposures, the positive basophilic aggregation test stands in some relation to lead absorption and its subsequent action.

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Anthrax from Infected Shaving Brushes

THREE years ago a consignment of 12 shaving brushes came into Lambeth (a district of South London) and found to be infected with anthrax. The health officer seized 11, but the 12th had been sold and could not be traced. Every one of the 11 was found to be infected with anthrax. The brushes had apparently come from Germany and were sold wholesale at the rate of 6 for 30 cents. The ministry of health issued a warning concerning the brushes to the hospitals and newspapers in the neighborhood. At last the brush has been found, but unfortunately as the result of a fatality. At an inquest on a boot repairer, who died in the neighboring district of Brixton, the pathologist stated that death was due to anthrax and that the brush was freely infected with the bacilli and spores of anthrax. The health officer gave evidence that a man might use an infected shaving brush every day for 2 years with impunity until he cut himself and became infected. The coroner remarked that the only satisfactory feature about the case was the vigilance exerted by the health authorities.—London Letter, *J.A.M.A.*, Aug. 10, 1935.